Beyond stormwater to create resilient communities

Stantec Technical Director **Chris Digman** looks at what the future holds for coping with the challenges of managing stormwater, recognizing the industry cannot continue successfully with traditional methods.

Almost all human activity depends on water. For years in the developed world, there have been significant investments in providing systems that bring in drinking water and take away stormwater and waste. But in many urban areas, these systems are now outdated and difficult to replace. Infrastructure was designed to standards that are no longer applicable to current pressures, let alone those of the future. As a result, when failure occurs cities and towns are not as resilient to flooding and pollution as they should be, making it difficult to bounce back and recover quickly.

Planning for and managing current and future risks is difficult. Increasingly complex and interconnected networks of stormwater, wastewater, and water supply (let alone other system interfaces) face unprecedented economic, social, geopolitical, and environmental challenges. The prevailing focus over the last couple of decades has been on growth, climate, and environmental issues. But today, more than ever, there are societal pressures to deliver a service that is resilient, protects the environment, and offers value.

Therefore, untangling and understanding the relationship between different water systems – with their internal and external pressures and drivers – remains central to solving challenging issues. To create resilient systems of the future, it is necessary to learn from the past and look to different models and approaches.

Understanding the enablers for change

To get a full understanding of this challenge, it's essential to think bigger and wider and go beyond water. For example, just by exploring the question of "in the future, how will we travel?" one might start to envision an environment for stormwater management that looks very different from today, and which might alter the actions taken now. For example, technology advancement in the automotive industry has been rapid, and its implementation over the next two decades is likely to create reduced vehicle ownership and autonomous vehicles to move people and goods. Such effects would reduce the need for parking at residential and business properties and could also result in the reduction in highway size. This would also create several benefits within the water industry: Fewer hard surfaces would be necessary and could be converted or replaced, reducing the amount of runoff from rainfall events. "Green" travel would create less polluting runoff entering drainage systems and subsequently watercourses. And, more space would be available to install measures to control the aboveground flows.

Other possible future scenarios, not necessarily water-related, that will change how stormwater is managed include:

- Resilient cities that evolve to cope with shocks – through socio, political, technocratic, and institutional cooperation – so they adapt better to extremes of drought, heat, and rainfall
- Digital intelligence that analyzes (with the right sensors) the vast amount of data to enable improved system operations
- Robotics & nanotechnology that enable inspection and repair of existing assets quicker, cheaper, and critically, at the right time
- Systems integration that brings together (not just technically) how we co-plan and finance to manage what we need and operate less in silos
- Water and wastewater as a resource to change how potable water is distributed to ensure long-term supplies
- Society becomes fairer with a better distribution of health and wellbeing
- People become reconnected with water, and through their actions it changes the needs and activities of those who provide services.

Collective action creates significant change

How might these enablers be brought together? Four overarching elements are likely to be key: integration, connection, resilience, and context. Water and wastewater operators should ask:

1. How water systems can be fully **integrated** – something that is within their control
2. How systems can be **connected** – which is potentially the most important and impactful element since a cost-effective and affordable service needs to be implemented and delivered inside and outside of the water industry
3. How **resilience** can be created and the what steps are necessary for success
4. Lastly, as it is now, one size will not fit all in the future. Critically, the **context** must be considered.

Taking a system of systems approach

Infrastructure systems are siloed, especially within water. The quicker the water sector begins to consider other systems' plans,

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programs, and their effects, the sooner opportunities to radically change what is achievable arise. For example, the future transportation of people and goods will create the opportunity of space – a key challenge in managing stormwater. If energy creation becomes more distributed, even down to a property level, what co-services could be created to ensure its longevity with managing water reuse?

Connecting systems will provide insight and visibility not previously understood and will provide opportunities that have been missed for years. Simply put, program management can be used to make significant efficiencies. While this means there must be co-creation to understand each other's needs, future directions, and technologies, large steps can be taken now. For example, identifying what programs of work will take place and how they can be prioritized. This will require alignment of programs and connection of contractual conditions, but if all stakeholders are moving towards similar outcomes for society, it is the political will and the governance structures put in place that can help determine how to make this work.

Flow chart reveals the impact of how removing stormwater through rainwater harvesting may have on the wider network and catchment. Blue is the starting point, orange is an end point and the varying effects captured in grey.

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Planning and integration within grasp

Recently in the United Kingdom, stormwater and wastewater management long-term planning has gained a more formal footing, through Drainage and Wastewater Management Plans.

Critically, however, when we create long-term plans, we don't start from today and look forward, we must envision our future now and work backward. It is necessary to recognize the consequences and lock-in that some decisions create, and plan collaboratively within the water environment. Integration between water, wastewater, and stormwater will be key.

Though this sounds simple, the regulatory institutions (both environmental and economic) must play a key role in how this is achieved. They can encourage, influence, and drive certain behaviors. Governments, therefore, must recognize this and evolve accordingly to enable this transformation.

So, whether it's single or multiple organizations, it is necessary to work collaboratively and co-create integrated long-term plans. This will require an understanding of not only technical aspects, but human behaviors (within organizations and the public) to create enabling working arrangements.

However, decisions can have wide-reaching consequences. In taking a simple approach of removing stormwater from the combined sewer system, it is necessary to understand what this truly means.

So, while retrofitting sustainable drainage forms part of the answer, it may be necessary to leave some areas connected – at least in the short term – to enable the flushing of systems.

Creating a resilient future

A slow move to distributed systems, like with energy, is already underway. But there is a long way to go before stormwater is widely distributed and viewed as a resource to be treated and managed on a local level, removing the reliance on buried infrastructure and end-of-pipe solutions. Digitization, social mobilization, and good governance will all be crucial to a resilient future in water.

Today, events can be predicted in real time and flows can be managed with dynamic modelling and digital twins using existing tools. This will help during extreme rainfall to optimize when and where to flood.

Autonomous robotics are in development that will inspect infrastructure and highlight when interventions are needed before they become a problem – enabling more sustainable solutions and more innovative local control structures to be more reliant and trustworthy.

Although decision-making using data and digitization is going to be key in the future, another parallel approach is needed. Although technology may play its part, the human interface will be critical to create change. The current reliance on technical approaches needs to be reduced and transitioned to applying more societal-based solutions. Critically, this is not solely focusing on behavioral change, as this tends to focus on the public being the problem and assumes people choose their behaviors. Whereas, what people do is often highly constrained and influenced by structures, norms, and habits. To mobilize society to be part of the solution, participation becomes key. This will require many individual and community-wide conversations to overcome the numerous social hurdles.

Finally, evolving governance to help overcome challenges will be necessary. Many in the industry recognize that change in legislation and regulation could support and direct decision makers to connect systems together (such as defining requirements on new developments). This could become standard instantly resulting in zero runoff, and utilization of sustainable drainage systems that collect, treat, and enable water to be reused to minimize potable demand.

Realizing opportunities of different contexts

To achieve the goals of connecting systems, integration, and creating resilience, it is necessary to recognize that different strategies and tactics to maximize opportunities are necessary. If these opportunities are missed, they may disappear or be locked away for decades or even centuries – something communities can ill afford financially, socially, or environmentally.

For example, in retrofit, it is necessary to utilize public open space and even more critically, private properties. To be successful, both require a reliance on working with

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Events 2019

2019

September

21-25 Chicago, Illinois, USA
WEFTEC 2019, 92nd Annual Technical Exhibition & Conference, Stormwater Congress
www.weftec.org

October

7-9 Monterey, California, USA
California Stormwater Quality Association
www.casqa.org

15-16 Villanova University, Pennsylvania, USA
2019 PA Stormwater Management Symposium
www1.villanova.edu

21-24 Singapore
The Year in Infrastructure Conference, YII 2019 Awards, organized by Bentley Systems
www.yiibentley.com

October

22-24 Dubai, UAE
The 21st Water, Energy, Technology, and Environment Exhibition, WETEX 2019
Organized by Dubai Electricity and Water Authority
www.wetex.ae

November

5-8 Amsterdam, The Netherlands
Aquatech Amsterdam Exhibition for Process, Drinking, and Wastewater, co-located with Floodex Europe 2019, both part of Amsterdam International Water Week.
www.aquatechtrade.com

13-15 Chicago, Illinois, USA
Storm Water Solutions Conference & Expo, organized by Scranton Gillete
www.swsconferenceexpo.com

December

2-6 Las Vegas, Nevada, USA
American Rainwater Catchment Systems Association 2019 Annual Conference and Expo. Co-located with Irrigation Association's 2019 Irrigation Show and National Ground Water Association's Groundwater Week Summit

2020

March

15-17 Cincinnati, Ohio, USA
WEF National Stormwater Symposium
www.wef.org/events/conferences/

July

5-9 Singapore
Singapore International Water Week 2020
Held in conjunction with World Cities Summit and CleanEnviro Summit Singapore
www.siww.com.sg

NGICP Events (USA)

October 7-11 (Monday – Friday)
Training provided by Trevor Smith, Licensed NGICP Trainer
Hopkinton, Massachusetts

October 17-November 14 (Five consecutive Thursdays)
Training provided by Holly Hudson, Licensed NGICP Trainer
Pittsburgh, Pennsylvania

December 2-6 (Monday – Friday)
Training provided by Georgia Association of Water Professionals
Marietta, Georgia

December 2-6 (Monday – Friday)
Training provided by Trevor Smith, Licensed NGICP Trainer
Hopkinton, Massachusetts

For more information about the National Green Infrastructure Certification Program (NGICP), contact NGICP@wef.org.

quality professional interested in permeable pavement.

Basic design guidelines are applicable in various climates and topographies. For example, recommendations in the document include:

- Ensuring that at least 0.6 meters (2 feet) of space remains between the bottom of a permeable pavement system and the underlying aquifer's seasonal-high water table
- Designing the system based on elevation and precipitation, such that runoff exits the system within 24 to 72 hours
- Locating permeable pavement systems far away from sites where any hazardous materials run the risk of spilling and contaminating soil and groundwater supplies.

The guide is particularly useful in green infrastructure training courses, which are increasingly held in the US as nature-friendly designs like permeable pavements call for a new skillset not typically held by water professionals.

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people and communities.

New development will benefit from stronger policy and leadership, which replaces short-term financial gain, for a longer-term return, because it has been applied nationally. Creating a level playing field could quickly enable this step.

Redevelopment and regeneration are possibly the single biggest opportunity. Tackling the timing perspective could significantly reduce the comparative costs of retrofitting and tackle large areas at the same time. Understanding where these may occur, so different bodies can build in and align their own investment programs is fundamental.

Can the water sector rise to the challenge?

So, does the water sector have the foresight, creativity, and inventive capability to meet these challenges? Yes. The water sector is on the edge of a transformation in which layered systems can become interconnected. This will change how water, wastewater, and stormwater systems are planned, built, and maintained. In the future, water will no longer be in isolation but will work through integrated services that understand the consequence of each decision. And these integrated services will not stop there, but connect to other systems such as energy, health, and transportation.

> CONNECTING SYSTEMS WILL PROVIDE INSIGHT AND VISIBILITY NOT PREVIOUSLY UNDERSTOOD AND WILL PROVIDE OPPORTUNITIES THAT HAVE BEEN MISSED FOR YEARS.

Yet, it cannot be overlooked that as digitization and distributed systems are fully embraced, it is critically necessary to work with the world's greatest single asset: People.

Author's Note

Professor Chris Digman, an expert and recognized technical leader in urban drainage, specializes in wastewater and stormwater management, sustainable drainage, flood risk management, pollution control, and sewer solid movement. Based in Leeds in the UK, Chris has significantly influenced stormwater management practices in the UK and beyond. He has written industry-leading guidance, which covers surface water management and benefit assessments. Chris plays an active role at the University of Sheffield, lecturing and providing strategic advice.